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Theory and Practice of Swarf Reclamation

The reclamation of turnings and swarf generally, because of their ever-increasing production, has become an urgent problem, whilst coincidently, some of the means for ameliorating the situation are ruled out. No longer is it in the national interest that cast-iron borings should be packed in canisters and thus enveloped be charged into the cupola; while the use of wooden boxes, at one time practised in Scotland, is too expensive under war conditions. From a study of Mr. Edwards' figures as disclosed in his Paper on "The Effect of Scrap in the Blast Furnace Burden," printed in our last issue, the process does not look so attractive as cupola melting. It involves the reduction of silicon from minerals, instead of ferro-silicon additions or a smelting as against a melting process. The major difficulty with cupola melting is the physical condition of the swarf, hence the resort which is made to briquetting and packing in containers. Bearing this in mind, Mr. Wm. G. Buchanan has evolved a process of using liquid cast iron as a cement, the details of which we have already printed. At a very minimum here is the nucleus of a process well worth consideration as a means to reducing the ever growing stock pile. Heavy steel turnings are easily assimilated in the electric furnace, and the number of these plants is rapidly increasing. Iron turnings in the electric furnace need special consideration. The ordinary arc furnace is not too suitable, as the electrodes make holes in the scrap charging without yielding a working bath at the bottom; the sides of the hole do not fall in, but probably garnish themselves with a graphitic coating, forming an excellent insulation. The rocking type of furnace would eliminate this difficulty, and the rotary pulverised-fuel-fired type of furnace also makes an appeal on similar grounds, but there may be some practical snags of which we are unaware.

Where metal chills are used for taking care of over-metal, an experiment could be usefully made of lining the bottom of each one with a few pounds of borings. In some foundries a considerable quantity might be absorbed at a minimum of expense. In this connection we have in mind the type of foundry which has thought it worth while to install a conveyor made up of chill moulds for transporting the over-metal back to the cupola charging-stage for remelting. To solve the question of the large-scale absorption of iron swarf when using liquid metal as a cement, however, demands movement, because the presence of graphite under quiescent conditions forms a refractory boundary which inhibits further action. Moreover, graphite is particularly difficult, if not impossible, to flux. This factor becomes apparent when melting iron borings in the arc furnace, where, to be successful, the operatives must be constantly pushing the charge beneath the arc. Even when a good bath is formed, the conditions appear to be that it is covered by a slag, superimposed by a layer of refractory graphite, and finally the borings floating thereon. Moreover, unless specially created, there is but little natural movement in the bath consequent upon exothermic reactions. Where such conditions are created, by the addition of iron ore or the like, then without serious metallurgical control, an iron yielding up to 19 tons tensile will be given. After some experience of the process, a routine schedule can be adhered to, but we would look for modifications in furnace design, rather than persevere with an initially difficult system. The cupola, though boundless experience has pointed to consolidation of swarf in some form or other, tackles the problem better than plant of open-hearth type because movement and the irregularities of the coke surfaces break up the graphite layers, so easily formed under quiescent conditions.

Where attempts are made to mix liquid cast iron with solid swarf, we suggest that a modicum of soda ash should be incorporated, as the gases which are evolved would help to create mechanical movement and so aid agglomeration. We were interested to learn that Mr. Buchanan has endeavoured to absorb steel turnings by mixing with liquid cast iron, though in this case we should hazard that, if anything, the process would be easier, owing to the increased weldability of mild steel.

In conclusion, the factors to be borne in mind in all attempts to reclaim cast iron borings are: (1) the production of a refractory layer of graphite which by insulation impedes the melting or agglomeration process; (2) there is an absence of exothermic reactions in the body of the metal, which retards action with metal as yet unmelted; (3) mechanical motion seems desirable, and (4) additions calculated to communicate movement to any bath of liquid metal which may be formed would appear to be helpful.

Ventilation of Anti-Glare Schemes

A number of foundries have provided anti-glare screening for furnaces, chiefly cupolas. This screening usually involves the top of the furnace and in many cases the charging hole and base also. Men are required to work at the charging hole and base, and in cases where space is restricted, lack of ventilation may have an adverse effect on working conditions during the coming warmer weather. Action should be taken well before the summer months, as otherwise output may be seriously reduced by unsatisfactory working conditions or by inadequate modifications to the screening, improvised at the last moment.

Foundries which do not operate into the black-out during the summer months may find it possible to remove and store part of the sheeting, replacing it when required next autumn. In cases where cupolas are operated during the hours of darkness in the hot weather, some modification to the screening may be required, such as the provision of sliding or hinged shutters which can be opened during daylight, or the provision of louvres to improve ventilation during black-out hours. In certain cases it may be found necessary to install fans to ensure an adequate supply of cool air.

Where such measures are required, a supplementary scheme should be drawn up and submitted to the British Cast Iron Research Association's Anti-Glare Advisory Committee as soon as possible. The Treasury grant of 50 per cent., payable on anti-glare schemes, will also be available towards the cost of approved schemes for ventilation. Any firms in doubt as to the adequacy of their ventilation after screening should communicate with the Association, and a visit from an anti-glare officer of the Ministry of Home Security will then be arranged.

Restrictions on "Luxury" Use of Steel and Copper

Further restrictions on the use of steel, copper and brass were announced on Tuesday by Mr. Oliver Lyttelton, President of the Board of Trade.

Steel will not be released for the manufacture for home civil consumption of bathroom fittings, sporting guns, metal windows, springs for upholstery and bedding, spring mattresses, metal bedsteads, musical instruments and pianos, hearth furniture, tops, sports equipment, umbrella components, metal furniture (certain articles), curtain rods of wire, lawn mowers, carpet sweepers, hand wringers, buttons, buckles and slides (except hair slides and harness buckles).

Copper and brass will no longer be released for home civil consumption for internal and external decorative and architectural metal work, furniture fittings for curtains, door-knobs and hearths, pot scourers and buckets, jewellery boxes, ash trays, mirror and photograph frames, bird cages, handbag frames, torch cases and cigarette cases, electroplate ware and certain electrical accessories.

War Damage Insurance

By a Board of Trade Order under Part II of the War Damage Act, 1941, the business insurance scheme came into force on Thursday, April 17. The private chattels scheme comes into force on May 1 next. The Orders prescribe the various forms of policies to be issued under the schemes and the conditions and limitations attaching to them. They are published as Statutory Rules and Orders Nos. 450 and 451 of 1941 respectively. On and after the dates mentioned application for insurance may be made to any of the principal fire insurance companies or to Lloyd's as agents of the Board of Trade, and one month's grace is allowed in the case of each scheme in which to apply for insurance. Copies of a memorandum explaining the schemes can be obtained on application to any of the Board's agents.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Core Drying Shells

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I was very interested in the article on core drying shells, in the JOURNAL of May 1, and I also note your own footnote.

It has been my good fortune to work with metal shells instead of "bedding," but now, owing to the scarcity of metal, one has to think of other ways of doing the same thing. I myself had occasion to give this subject much thought, and had trials which were very successful.

Six matrix faces were cast in the wooden core box with plaster of paris; on to these plaster matrices a well tapered frame was built. Then the whole plaster box was varnished ready to be used as a core box for the bedding pieces. Then a core was rammed up out of this box and put in the stove to dry.

A core was then rammed up in the wooden box and, after lifting off the half-box which had had the plaster matrix cast in it, the core which had been made in the plaster box was placed on the green core, and a plate put on; the whole lot was then turned over and the other half of the box taken off, leaving the core in a solid bed with no fear of sagging or losing shape.

The reason for casting six plaster faces was on account of any damage which may have occurred to these faces during working; the core box had a lot off, and therefore wore in certain parts. Thus, had we only cast one plaster face, besides having to wait for the core box to come off the bench to make another plaster cast, we should also have had irregularity of faces owing to wear on the corebox, thereby losing correct seating of the core.—Yours, etc.,

G. L. FISHER.

Sheffield.

Welsh Scrap Trade

Mr. Edgar Rees, who was re-elected President of the South Wales and Monmouthshire Association of Tinplate, Iron, Steel, Metal and Scrap Merchants at Swansea last week, said that the scrap trade had rendered excellent service during the critical war period. Although handicapped by shortage of labour and transport, the trade had worked long hours and at week-ends to keep up the supply of raw material, and it was to their credit that no iron or steel works had yet stopped for want of deliveries. The supply must, however, be maintained, and if the public would play their part by releasing any iron and steel scrap, the scrap trade could be relied upon to play its part in preparing such material for the furnaces.

The retiring officers—Mr. Edgar G. Rees, Llanelly, President; Mr. W. Harries, Morriston, Vice-President; Mr. J. D. D. Davis, Swansea, hon. treasurer; and Mr. R. W. Perrott, Neath, auditor—were re-elected, as were the following members to the Committee:—Messrs. R. W. Davies, Swansea; J. H. George, Morriston; Rhys. W. Harry, Llanelly; W. C. Howe, Swansea; W. I. Lane, Swansea; E. G. Mort, Briton Ferry; T. Vaughan Rees, Llanelly; Tom White, Newport; D. E. Wilson, Llanelly; and A. Ettery Wood, Newport.

(Continued from next column.)

"Heavens!" cried that youngster, his eyes opening wide in astonishment, "what on earth time do their kids go to school?"

* * *

Correction. An apology is due to the Clan Menzies, because the printers misspelt the old form of the name, which appeared in last week's column. It should read Mengues.

"MARKSMAN."

Random Shots

There was more than one unusual feature about the luncheon held last Saturday at the Dorchester by the London Branch of the Institute of British Foundrymen. First, the numbers were less, though not much, than in past years, which was inevitable with so many spare-time war activities to be attended to, and that, combined with the fact that it took place in a smaller room than is usually associated with functions at the Dorchester, gave the gathering an unusual air of intimacy and friendliness.

* * *

Secondly, the President, Mr. Barrington Hooper, rendered an excellent speech all in rhyme, which no doubt he had composed whilst firewatching in the brilliant moonlight of the few previous nights. It looked, too, as if the moonlight had struck another speaker in the very same way, for the Honorary Secretary, Mr. V. C. Faulkner, not to be outdone, produced an apology for absence, also in rhyme. Mr. C. C. Booth will be interested to hear how his apology was delivered:

"When you're lunching, think of me, Sir,
Think of me, Sir, at the butts;
I'll be shooting, I'll be shooting,
With a lot of other mutts.
Each time that I get a bull's eye,
Or a magpie, or an inner,
Then I'll think, Sir; then I'll think, Sir,
That it's better than your dinner.
But should shooting only bring me
Nothing better than an outer,
Then I'll say, Sir, I'd be better
Drinking beer and getting stouter."

* * *

The third unusual note was struck by the distribution of presents to the ladies. These were confined to four or five, and the lucky ladies were chosen by a system of cutting a pack of Kan-U-Go cards to spell out the recipient's christian name. They were won respectively by Ida, Sally, Phyllis and Kathleen. Anyone who has tried his hand at producing an article for the Journal knows how Mr. Faulkner can juggle with words in an official capacity, but few have seen him making a game of it in public.

* * *

It is recorded in the "South African Foundryman and Engineer" that the members of the South African branch of the Institute of British Foundrymen partook of a dinner in February entirely by candlelight. There was to be a lecture afterwards by Mr. McLure Renwick, who "was resigning himself to the ordeal of reading his Paper by the uncertain light of candles, when the obvious faith of the members in the resourcefulness of the city's electricity department proved justified." It is strange to read of such happenings in a country so far away from the war zone for here one naturally thinks of candlelight as being "the result of enemy action." It is even doubted whether any branch in this country has yet been obliged to hold its meeting or dinner under similar conditions, in spite of the bombs, the landmines, the H.E.s and other such temporary disorganisers of civil life.

* * *

A certain youngster was having his breakfast, and, wishing to impress his mother with the earliness of his rising, said to her: "Do you realise that I am really going to school at ten to seven instead of ten to nine?"

The 8 o'clock news was switched on at the time, and just at that moment it announced "Mr. Stimson said the Nazis had put back the clock five centuries."

(Continued at foot of previous column.)

The Polishing of Cast-Iron Micro-Specimens and the Metallography of Graphite Flakes*

(Slightly Abridged)

By H. MORROGH

This Paper is concerned exclusively with the preparation of specimens of grey cast iron. White irons not only avoid the special difficulties due to graphite, but are generally quite easy to prepare.

That cast-iron micro-specimens are difficult to polish and that there is a very urgent need for standard methods of preparation of metallographic specimens is indicated by the many and varied results obtained by different investigators. Most text-books of metallography give a description of a process whereby metal micro-specimens can be obtained flat, polished free of scratches and suitable for observation under the microscope. In general, metallographists have acquired this technique and can now produce, fairly easily, metal specimens so polished. Unfortunately, from the point of view of the preparation of micro-specimens, cast irons have a combination of constituents which among the common metals is unique in so far as a soft and very friable substance, namely, graphite, occurs surrounded by a relatively hard, but metallic, matrix which nevertheless has a measure of plasticity. A perfectly prepared micro-specimen of grey cast iron would have a metallic matrix polished free from scratches, and in this matrix would be graphite flakes also polished smooth and free from scratches, their surfaces being level with the polished metal surface. When a "general" metallographic technique (*i.e.*, one recommended for any ferrous metal) is applied to grey cast iron, even though the metallic matrix may be polished correctly, the graphite flakes are seldom, if ever, polished at all. The peculiar friability of graphite flakes results in the substance being torn out wholly or in part from the cavities which are either opened up or burnished over, according to the particular type of polishing procedure.

As a result of the tendency for graphite to be torn out, metallographists have almost become resigned to the fact that in a cast-iron specimen, one must see not the actual graphite flakes, but cavities where the graphite flakes existed prior to the polishing operation. It is the purpose of this Paper to point out that perfectly polished micro-specimens of grey or malleable cast iron can be obtained with the graphite intact, to give a description of the process used, and to indicate what parts of a general technique should be avoided if perfectly prepared specimens are to be obtained.

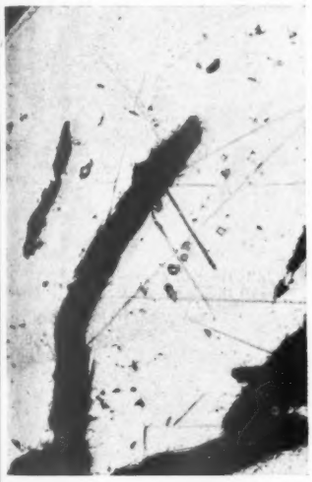


FIG. 1.—INGOT MOULD SPECIMEN, AFTER PREPARATION ON CARBORUNDUM AND ALUMINA. GRAPHITE TORN FROM SPECIMEN. × 200.

FIG. 2.—SAME SPECIMEN AS FIG. 1, AFTER REGRINDING AND RUBBING SUCCESSIVELY ON 1*G*, 1*F* AND 00 EMERY PAPER. GRAPHITE RELATIVELY UNDAMAGED. × 200.

FIG. 3.—SAME AS FIG. 2, AFTER POLISHING ON CHROMIUM OXIDE. GRAPHITE TORN OUT. × 200.

FIG. 4.—SAME AS FIGS. 2 AND 3, AFTER 30 POLISHINGS AND ETCHINGS. POLISHING POWDER, MAGNESIUM OXIDE. GRAPHITE INTACT. × 200.

Use of Loose Abrasives

Most metallographic specimens are, in the initial stages, either ground or filed flat and

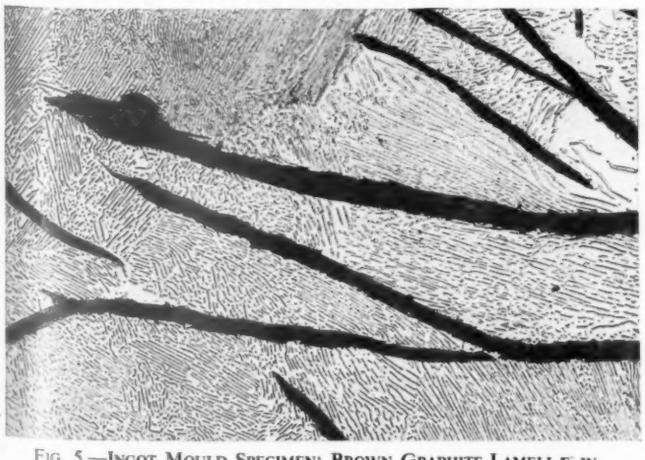


FIG. 5.—INGOT MOULD SPECIMEN; BROWN GRAPHITE LAMELLÆ IN PEARLITIC MATRIX. ETCHED IN PICRIC ACID. × 500.

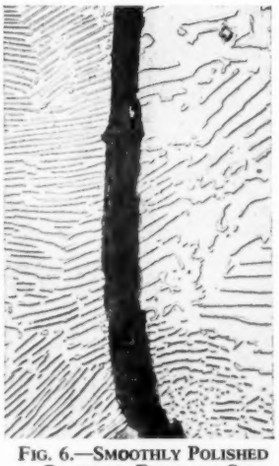


FIG. 6.—SMOOTHLY POLISHED GRAPHITE FLAKE IN SAMPLE OF PIG-IRON. ETCHED IN PICRIC ACID. × 1,000.

FIG. 7.—COMMON IRON; GREY-BROWN GRAPHITE LAMELLÆ IN FERRITE WITH PEARLITE AND PHOSPHIDE EUTECTIC. SECONDARY GRAPHITE IN THE FORM OF "FLUFFY" MARKINGS ALONG THE EDGES OF THE GRAPHITE. ETCHED IN PICRIC ACID. × 500.

* A Paper presented to the Spring Meeting of the Iron and Steel Institute.

then treated in some way, so that the relatively coarse scratches produced by the grinding wheel or file are removed and replaced by finer scratches, which can in turn be easily removed by the polishing powder. The methods by which the specimen is smoothed prior to polishing may be roughly divided into two classes. The first class includes those methods which use a series of loose abrasives, and the second includes those methods which use successively finer grades of emery paper. For this purpose the second method is to be preferred, the objection to the first method being that while satisfactory metal surfaces can be obtained, the graphite flakes are nearly always more badly damaged than in specimens prepared by an emery paper method. Fig. 1 shows a micrograph of an ingot mould specimen after the removal of grinding marks by carborundum and coarse alumina; Fig. 2 shows a micrograph of the same specimen after regrinding and rubbing successively through finer grades of emery paper. It is seen that in the latter case the graphite flakes are in a much better state of preservation than in the former, which shows cavities and not graphite. It can therefore be said that methods using loose abrasive in the preliminary stages are to be avoided if perfectly polished cast irons are to be obtained.

Fig. 8.—Graphite Flakes in Ingot Mould Sample. Black Spots due to their Slightly Damaged Surfaces. Unetched. × 50.

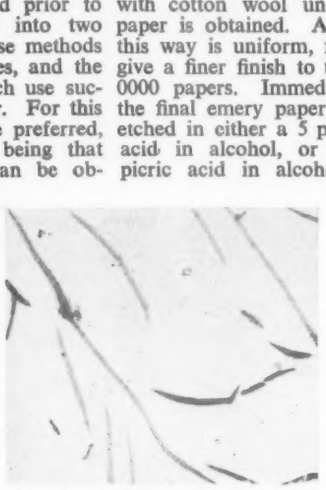


Fig. 9.—Section of a 1.2-in. dia. Test Bar. Note Smooth Surfaces of Graphite Flakes. Unetched. × 200.

Fig. 10.—Graphite Flakes at a High Magnification. Some Flakes appear Light Grey, others Black. × 1,500.

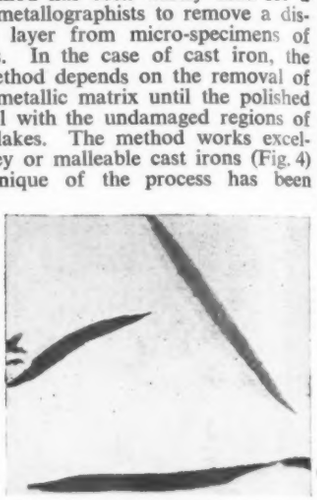


Fig. 11.—Same as Fig. 10 with Specimen Rotated through 90 deg. Graphite Flakes formerly Black now Light Grey, and *vice versa*. × 1,500.

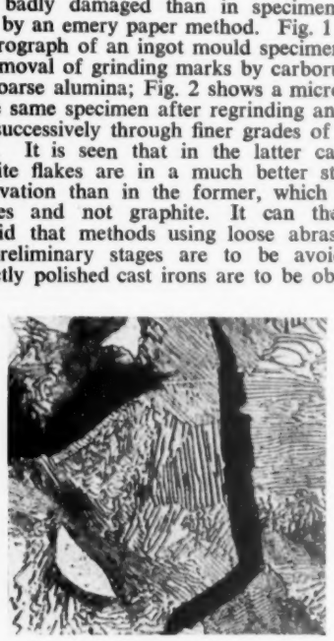


Fig. 12.—Graphite Flake in its Brightest Position. Etched in Picric Acid. × 2,000.

Use of Emery Papers

With regard to the use of emery papers, the following procedure has been found to give good results: Starting from a freshly ground surface, rub the specimen through a series of three emery papers, grades 1G, 1F and 00 (or their equivalents). The rubbing should be slow and the specimen should be pressed very firmly to the paper so that the operator can feel the surface being cut. The presence of small particles of grit between the paper and the specimen tends to tear out the graphite, and these can be removed by blowing or shaking the paper. It is not necessary to introduce more papers into the series mentioned above, since they introduce more complications, and increase the time of preparation per specimen. Papers finer than 00, such as 000 and 0000, are frequently uneven and gritty, and a fine paper can be prepared from a piece of used 00 paper. Methylated spirit is dropped from a spotting bottle on to the paper. This is then rubbed with cotton wool until the required type of paper is obtained. A final paper produced in this way is uniform, free from grit and it will give a finer finish to the specimen than 000 or 0000 papers. Immediately after treatment on the final emery paper, the specimen should be etched in either a 5 per cent. solution of nitric acid in alcohol, or a saturated solution of picric acid in alcohol. A specimen rubbed down and etched in this manner is ready for polishing.

Final Polishing

About the final polishing there is a very general agreement as to how it should be performed. Most polishing machines have a revolving wheel to which is attached a piece of soft cloth impregnated with polishing powder.

Polishing cloths with a high pile tend to dislodge the graphite in a similar manner to loose abrasives and free particles of grit on the emery papers. To preserve the graphite, it is best to polish with a cloth having very little pile. Vilella has suggested the use of the dull side of a heavy pure silk satin, but this type of material does not retain the polishing powder during the rotation of the pad. If, however, Selvyt cloth be used, the pile becomes flattened and the cloth apparently smooth in a short time after the beginning of polishing. A suitable speed for the polishing wheel is about 600 r.p.m. Higher speeds give faster polishing, but the polishing powder is thrown off the wheel more easily.

The possible polishing powders, namely, chromium oxide, rouge, zinc oxide, manganese dioxide, tin oxide, magnesium oxide and Diamantine (a specially prepared form of alumina), vary considerably in their ability to polish cast irons without tearing out the graphite. Diamantine and magnesium oxide tend to leave the graphite undisturbed, polishing it at the same time. The other polishing powders, chromium oxide in particular, produce similar effects to loose abrasive. Fig. 3 shows the same spot as Fig. 2 after polishing on chromium oxide. It is seen that the surface of the graphite has been badly damaged and the width of the graphite lamellæ increased. Of the two polishing powders, Diamantine and magnesium oxide, the former is to be preferred, since it polishes very much more quickly, although where the price of Diamantine prohibits its use, magnesium oxide can be used satisfactorily. The latter requires more polishings and etchings than the former and hence takes more time.

Alternate Polishing and Etching

Even with the use of Diamantine or magnesium oxide, it is only rarely that perfectly polished specimens are obtained after one polishing operation. To overcome this difficulty, Hanemann and Schrader have recommended the use of alternate etching and polishing. This method has been widely used for a long time by metallographists to remove a distorted surface layer from micro-specimens of various metals. In the case of cast iron, the use of this method depends on the removal of layers of the metallic matrix until the polished surface is level with the undamaged regions of the graphite flakes. The method works excellently with grey or malleable cast irons (Fig. 4) and the technique of the process has been worked out by the author and satisfactorily employed on a large number of varied types of irons, typical examples of which are shown in Figs. 5, 6 and 7, in all of which Diamantine has been used. Particulars of this process are given in the following:—

The polishing powder, 250-mesh Diamantine, is mixed with water in the proportions 50 grms. of Diamantine to 100 ml. of water, so that a fairly thick paste is formed. Frequently in the literature it is recommended that the polishing powder should be mixed with much water. The thick paste is preferred, however, because the pad is likely to be used several times for each lot of Diamantine applied to it, and when in paste form it tends to be retained by the wheel more than when used in the watery condition. Diamantine paste in an amount equal to about 15 ml. for a 6-in. dia. wheel, is put on the pad and rubbed well into the pile with the fingers. A pad prepared in this way will polish out the scratches from the emery paper in times varying from about 20 sec. to 2 min., depending on the type and size of the specimen.

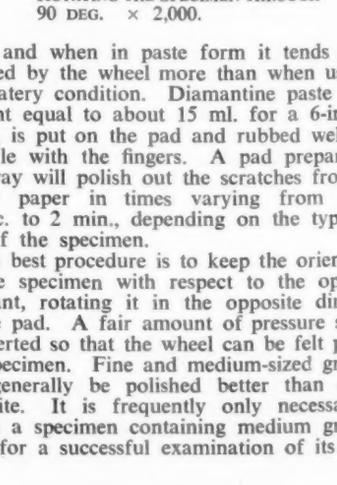


Fig. 13.—Same as Fig. 12 after Rotating the Specimen through 90 deg. × 2,000.

The best procedure is to keep the orientation of the specimen with respect to the operator constant, rotating it in the opposite direction to the pad. A fair amount of pressure should be exerted so that the wheel can be felt pulling the specimen. Fine and medium-sized graphite will generally be polished better than coarse graphite. It is frequently only necessary to polish a specimen containing medium graphite once for a successful examination of its struc-

ture. After the first polishing operation, the pile of the pad should not be disturbed; one made up in the above way will last for twelve additional polishing operations, any further polishing making the pad more nearly ideal for the preservation of the graphite.

If, after the first polishing operation, the graphite is torn out, opened up or burnished over, as is usually the case, the specimen should be re-etched and polished again; the time required to polish off the etching depends on the specimen, but generally 10 sec. is ample. It is not even necessary to wait for the removal of the emery paper scratches before the etching and polishing operations begin; in fact, the disappearance of the scratches is made more rapid by etching before the scratches have disappeared. By protracted etching and polishing the graphite flakes gradually assume a light grey to brown colour, serrated edges tend to disappear and any burnishing or opening is removed.

FIG. 14.—GRAPHITE FLAKES IN INGOT MOULD SAMPLE. TAKEN WITH A GLASS SLIP REFLECTOR FOR VERTICAL ILLUMINATION. UNETCHED. × 200.

FIG. 15.—SAME AS FIG. 14 BUT TAKEN WITH A METAL REFLECTOR FOR VERTICAL ILLUMINATION. × 200.

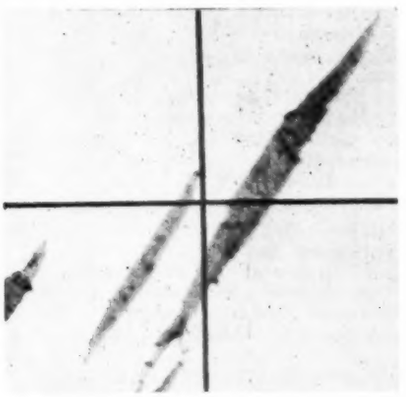


FIG. 16.—UNIFORMLY COLOURED GRAPHITE FLAKE. UNETCHED. × 2,000.

Etching Reagents

The choice of etching reagent is of some importance in the repeated polishing and etching operations. It is necessary to use an etching reagent which actually etches the metallic matrix. For pearlitic grey irons or for irons containing more than 50 per cent. of pearlite in the matrix, both nitric acid and picric acid produce similar effects with regard to the polishing of the graphite. In the case of ferritic grey irons and ferritic black-heart malleable irons or irons containing less than 50 per cent. of pearlite in the matrix, nitric acid is definitely preferable and produces the desired effects more rapidly than picric acid. In some cases, when the specimens have very coarse graphite in a ferritic matrix, it is almost impossible to remove the burnished and flowed layer from the graphite using picric acid; nitric acid will do this quite readily.

When two samples of closely similar graphite size have to be compared, there is frequently some doubt cast on the verdict, since one specimen may be slightly burnished, giving the appearance of a fine graphite size, or it may be "opened," giving the appearance of a coarse type of graphite. If specimens are prepared by alternate etching and polishing, any burnishing or opening of the graphite is removed and accurate comparisons of the length and width of graphite can be made.

Phosphoric irons are more difficult to polish by this method than hematite irons, because the phosphide eutectic tends to stand up in relief; this can be avoided if the times of actual polishing are increased.

Correctly prepared samples bring into photomicrography another element of difficulty. Improperly prepared samples show the graphite as a black constituent and the matrix white, forming an easy combination to photograph with a contrasty plate; on the other hand, the photography of samples prepared by the improved technique requires a less contrasty plate and more accurate control with respect to exposure and development.

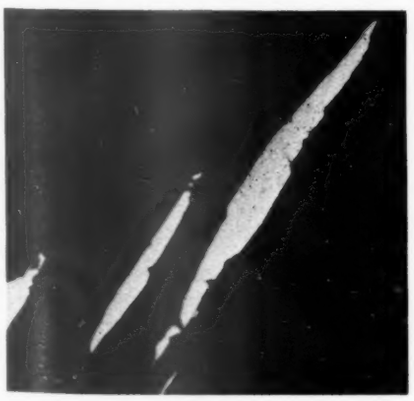


FIG. 17.—SAME AS FIG. 16 WITH CROSSED NICOLS. GRAPHITE FLAKE IN POSITION OF MAXIMUM BRIGHTNESS. × 2,000.

Internal Structure of Graphite in Specimens Prepared by the Improved Technique

When the graphite flakes in a carefully prepared sample of cast iron are examined at a low magnification (50-200 diameters) they appear to be light grey to brown in colour; any defect on the surface of the graphite gives it a black appearance (Figs. 8 and 9).

At high magnifications (generally above 500 diameters) the colour of any particular graphite flake depends on its position relative to the glass-slip reflector of the microscope, with the result that some graphite flakes appear light grey, some black and some of intermediate tone. On rotating the specimen through 90 deg., keeping the glass-slip reflector still, those flakes formerly black become light brown and *vice versa* (Figs. 10, 11, 12 and 13).

When a beam of light is reflected from the surface of a transparent substance, it is partly polarised, the vibrations being parallel to the reflecting surface; in this way the beam of light from the illuminating train of a microscope after reflection from the glass slip is partially polarised. Certain portions of the spectrum are absorbed when a beam of light is reflected from a coloured substance, and the complementary colours are seen. With some anisotropic substances, the wave lengths removed depend upon the plane in which the incident light is vibrating and its relation to the optic axis of the crystal; this latter phenomenon is referred to as reflex pleochroism. Graphite exhibits reflex pleochroism and this accounts for the changes in colour of graphite flakes on rotating the stage when the illuminating system is of the glass-slip reflector type. That the manifestation of this optical property of graphite is due to the glass slip alone is shown in Figs. 14 and 15.

Fig. 14 shows two graphite flakes at right angles; the micrograph is taken with the usual type of glass-slip reflector and it is seen that one flake is dark and the other is light; Fig. 15 shows the same spot taken using a metallic reflector, which fills only a portion of the back lens of the objective with light. In this case, both flakes show the same absorption, since this reflector does not polarise the light. The relation between the plane of polarisation of the incident light and the positions of maximum and minimum brightness of graphite flakes is such that when the plane of polarisation is at right angles to the graphite flakes, they appear dark, and when parallel to the graphite flakes they appear bright. If the glass slip is rotated through the same angle as the specimen, no change in brightness of the graphite is observed. If a single nicol prism be inserted in the illuminating beam so that the plane of polarisation of the light passing through it is parallel to that of the light reflected from the glass slip, then the effect of the pleochroism is more marked, since the light incident on the specimen is almost completely polarised.

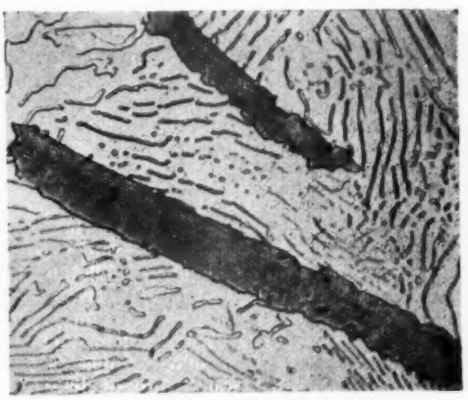


FIG. 18.—CYLINDER LINER SAMPLE; UNIFORMLY COLOURED GRAPHITE FLAKE IN BACKGROUND OF PEARLITE. ETCHED IN PICRIC ACID. × 1,000.

When viewed under ordinary illumination, a number of graphite flakes appear to be uniform and similarly oriented throughout their lengths and breadths; that is, in one particular position with respect to the illuminating system, the whole of a graphite lamella is of the same colour (Fig. 18).

(To be continued.)

D

Blast Furnace Air-Conditioning Plant in the U.S.A.

No. 1 blast furnace at the Aliquippa Works of the Jones & Laughlin Steel Corporation is installing air-conditioning equipment capable of removing from seven to forty tons of water per day from the air blown into one of the world's largest blast furnaces, in order to more closely control the quality of the iron produced. The equipment will be used to maintain a constant low moisture content in the air blast, eliminating the necessity of trying to forecast the weather 24 hrs. in advance of charging the furnace. Due to the fluctuating moisture content of the atmosphere, operators must constantly change the proportions of raw materials charged into the furnace, which approximate 2,000 tons of iron ore, 950 tons of coke, 500 tons of limestone, and 4,000 tons of air per day to produce 1,000 tons of molten pig-iron.

Ordinarily, wide fluctuations in humidity have caused irregular blast furnace operation, which results in less iron production. On hot, humid days, more coke must be charged per ton of iron to offset the excess moisture in the air, which is blown into the furnace at the rate of 80,000 cub. ft. per min. This air carries with it into the furnace seven tons of water per day for every grain of moisture content per cub. ft., which has the effect on extreme days of pouring thirty or forty tons of water into the furnace.

With an air blast of constant humidity, it is possible to control the silicon content and iron temperature within narrow limits, which are two major factors having a direct bearing on steel quality. With such iron, the production of steel by both the Bessemer and open hearth processes can be increased. Further advantages are seen in a possible reduction in the amount of coke and limestone necessary to produce a ton of iron and an actual increase in iron production may be expected.

The air-conditioning equipment conditions the air by drawing it through two chilled water sprays, then passing it through eliminator plates where excess moisture is removed. The idea of conditioning the air blast to a furnace was first recorded about 1880, when attempts were made to regulate the moisture content of the blast by passing the air through calcium chloride, sulphuric acid and other chemicals. In 1890, James Gayley, a blast furnace operator at Pittsburgh, began his experiments using refrigeration to reduce the moisture. This led to the basic concept that the removal of water vapour from the blast would afford definite economies in coke and increase the output of the furnace.

During the first quarter of the century some nine installations were made. The equipment was cumbersome and required a huge capital investment, but the results proved that iron quality could be improved with a saving of coke and limestone by removing water vapour from the blast. The equipment, however, was not dependable, and it was difficult to operate, due in part to the formation of tons of ice on the air-cooling coils. All of these plants were finally dismantled.

The first modern installation was made by the Woodward Iron Company at Woodward, Alabama, in the summer of 1939. It condenses the moisture by cooling with direct sprays of chilled water. These sprays are cooled by a centrifugal refrigeration machine of 500 tons capacity, which is similar to the one being installed by Jones & Laughlin Steel Corporation. The American Rolling Mill Company, at

(*Continued in next column.*)

(*Continued from previous column.*)

Ashland, Kentucky, installed a chemical system of removing the moisture from the blast. The Woodward Iron Company recently installed a system in a second blast furnace, and has placed a contract for air conditioning a third blast furnace at Woodward. The company has stated that air conditioning had increased the pig-iron output of the two furnaces by 10 per cent. At the same time, the coke requirements of the furnaces were reduced by approximately 200 lbs. per ton of pig-iron.

Book Review

Fire Assaying, by O. C. Shepherd and W. F. Dietrich. Published by McGraw-Hill Publishing Company, Limited, Aldwych House, London, W.C.2. (Price 21s.)

The field covered by this book is contiguous to foundry practice, and it often happens that a routine chemist working in a steelworks or foundry laboratory finds employment as an assayer to some mining interests, believing that there is a chance to live a less confined existence. This book will foster such aspirations, as it is very unlike the average work devoted to cognate subjects, wherein there are many "recipes" unrelieved like standard cookery books by coloured illustrations of "jellies and boar's head in aspic." The authors, who are respectively Associate Professor of Mining and Metallurgy at Stanford University and teacher of Mining and Metallurgy at Sacramento Junior College, California, have not committed the fault of isolating the assayer within the four walls of his office. Throughout, he is shown to occupy an important position on the staff of mining concerns or establishments handling precious metals. There has been an *ab initio* recognition of the various types of individuals whose work demands access to a book of this character, and their requirements, be the seeker a practical assayer, an ex-laboratory boy working as an assistant or a University graduate, are splendidly catered for. The authors are half apologetic for the inclusion of Chapter VI, which is a theoretical discussion of assay fusions and related smelting processes, and even suggest that it might be skipped by the more practical type of reader. Actually, the reviewer found it very easy to follow and exceptionally interesting, more so perhaps than the very important chapter on sampling. Correct sampling in the precious metal field is more important than the actual assay. The chapter on cupellation reveals much progress since the reviewer first dabbled in the art, for indeed in those days cupellation was more of an "art" than a "science." Memory well recalls the charging of the lead button into the hot cupel, and the subsequent weighing and parting of the bead, but fails entirely to recall where the button came from. It was this search which caused the reviewer to read the book with more than usual interest and "where the button comes from," and its control as to size, forms one of the most interesting phases of applied metallurgy. No doubt there is a good deal of *experientia docet* about the whole subject, yet a profound understanding of metallurgy—especially of slag reactions—will help to reduce the time between sampling and the finished assay and to eliminate snags. The reviewer is not too familiar with the published literature on the subject of assaying, but instinct and a wide knowledge of metallurgical text books tells him that "Fire Assaying" will long occupy a prominent place as a standard work of reference on "specialised branch of metallurgy."

V. C. F.

Serious Delay Averted by Welding

The "Canadian Welder" relates how a five-weeks' delay in the delivery of an urgently needed cast-iron vacuum-pan drier for installation in a Canadian explosives plant was recently averted through oxy-acetylene welding with cast-iron rod. The job was notable for the size of the casting, which weighed over three tons, and the extent of the repair. Careful preheating, efficient application of weld metal, and close teamwork among the operators effected a completely successful repair without distortion.

The crack, 12 in. long, developed after machining, next to an opening in the 1¼ in. thick inner wall of the hollow jacket. Then, in veeing out the crack as a preparation for welding, it was found that the crack was in the centre of an area approximately 8 in. by 21 in. of unsound metal, all of which would have to be removed and replaced with cast-iron weld metal.

Several methods of repair were attempted without success. Even bronze welding was not feasible since the bronze weld metal would be subject to the chemical attack of materials in the drier during service. A welding engineer, called in to supervise the repair, advised oxy-acetylene welding with cast-iron rod after thorough preheating of the casting to avoid possible distortion during welding.

A temporary firebrick furnace was built around the casting and fired with charcoal. Heat was conserved by covering the furnace with a tent of asbestos paper through which holes had been punched for ventilation and for carrying away later the fumes from the area where the welding operator would work. After the casting had been uniformly heated, a welding operator set to work with a long-handled, heavy-duty welding blowpipe.

During welding three welding operators and one labourer worked in relays to fill in the large breach with cast-iron rod, treated with flux. Due to the intense heat resulting from the preheat, an operator would work only from three to four minutes, standing inside the casting. When he was obliged to leave his position the blowpipe was handed to the helper who kept the weld heated until a second operator could resume welding. Since the welding was practically continuous and the casting was held at a high temperature, with time out for only one additional furnace heating, the repair was a comparatively rapid one. After the opening had been filled in, and the casting cooled, it was necessary only to grind the weld to a smooth finish. A check gave no indication of distortion.

Gun Metal Test Bars

"Foseco News," the house organ of Foundry Services, Limited, of Long Acre, Nechells, Birmingham, devotes its latest issue (No. 49) to the overcoming of typical metal faults and the like. The most interesting case reported is that of gun metal test bars. Two boxes, cast immediately one after the other, gave persistently low elongation results on the second cast. By raising the casting temperature from 1,150 to 1,180 deg. C., the difficulty was overcome.

N.-E. Coast Institution of Engineers and Shipbuilders

At the general meeting of the Institution, held on April 25, the following elections to the Council were made:—President: Mr. W. A. Woodeson. Vice-Presidents: Messrs. Harry Hunter, Allan J. Marr, T. McPherson, and R. H. Stephenson. Ordinary Members of Council: Messrs. F. G. H. Bedford, P. B. Johnson, T. Morison, Dr. A. Pickworth, Dr. E. V. Telfer, and Mr. R. C. Thompson.

The Outline of Cupola Control

FURNACE, RAW-MATERIAL AND MELTING CRITERIA

By C. A. PAYNE

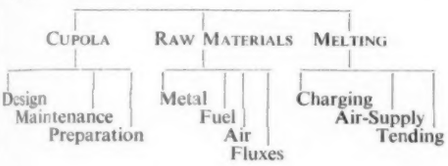
At the recent annual meeting of the EAST MIDLANDS BRANCH *of the* INSTITUTE OF BRITISH FOUNDRYMEN, *a Short Paper Competition was held, and five Papers were submitted, two dealing with the cupola, two with patterns, and one with piecework production. The titles and contributors of the Papers were:—*

- *"The Outline of Cupola Control," by A. C. Payne.*
- *"Oxidation in the Foundry Cupola," by W. McConnachie.*
- *"Pattern Shop Developments," by L. L. Cox.*
- *"Metal Patterns for the Foundry," by E. Holland.*
- *"Piecework and Production in the Foundry," by J. C. Hallamore.*

The prize-winning Paper, that by Mr. A. C. Payne, is reproduced here. The other Papers will be included in subsequent issues of the FOUNDRY TRADE JOURNAL.

The statement, "Every cupola is a law unto itself," is more correctly, "Every cupola operator takes the law unto himself." Melting metals in contact with solid fuel is based on fundamental chemical and physical principles. Variations in materials and melting conditions are the only causes of variations in the final product. Ideal conditions of chemical reactions cannot exist, but standardised conditions must be achieved for a control seeking maximum melting efficiency and a constant product. This is not necessarily molten metal at minimum cost per ton, but means minimum cost per ton of metal, converted into good castings.

This Paper expounds the following analysis of cupola control:—



The Cupola

Design

A given hourly tonnage is obtained under optimum conditions with a definite diameter inside the lining. All other dimensions can be expressed proportionally to this diameter. Height to charging-sill should give adequate cooling of gases by the stock without the weight of stock being sufficient to crush the bed-coke. The well-capacity, fixed by weight and rate of tapping, determines the height of slag-hole and tuyères.

The tuyère size should be adequate to admit the air for burning one coke charge in the requisite time. Tuyère shape should give uniform blast velocity and distribution, these being affected also by the dimensions—width especially—of the wind-belt. The blower should supply this air at minimum pressure consistent with penetration of the stock, the diameter of the blast-main giving minimum velocity changes.

The lining—parallel for best results—should keep the shell at reasonable temperatures, without being so thick as to raise structural and economic—replacement—difficulties.

Maintenance

Excessive lining irregularities indicate stripping and relining of the zones involved. "Armour-plating" below the charging-sill is to be recommended. Tuyères, on the first signs of warping or burning-on, should be replaced. Sight-holes and covers should be kept air-tight and easily manipulated. Leaks and obstructions in blast-main and wind-belt should be immediately rectified. Tapping and slag-spouts should be kept rigid, and replaced when burnt.

Preparation

This involves a definite routine, controlled materials, and efficient tools. Fettling, to remove slag and metal accretions, which overdone means excessive patching, and which insufficiently done involves unreliable patching. Patching, to restore the standard lining dimensions, requires minimum moisture compatible with plasticity and adhesion, maximum ramming, venting, and drying time. The bottom, of controlled material rammed to a standard slope, the tap-hole accurately located on this bottom, and the spout of consistent dimensions and uniform slope, are the final items.

Patching requires as long an air-drying as possible, final drying being by means of a fire kept below tuyère level. The bed-coke is put on a portion at a time, each portion burning through thoroughly before further additions. The bed-height, checked after poking and levelling, is fixed by the melting zone, and is a function of blast-pressure. Above this are required the layer of "safety-coke" and the layer of charge-coke for the first charge. The melting zone is best located by the position of maximum burning back of the lining.

Raw Materials

Metal Charges

Of each element to be controlled in the final product, the percentage present in every charge constituent—pig-iron, scrap steel, cast iron, etc.—must be determined. Mode of occurrence, and changes during melting, of each element affect the balance of the charge. Size, shape and cleanliness of materials are also vital points.

Fuel

Coke is essentially impure carbon. Carbon being the source of heat, impurities, as moisture, ash, etc., must be known. Impurities picked up by molten iron should be at a minimum. Strength, to support the charges in the cupola, should be at a maximum. Size, dependent on cupola diameter, should be regular.

Air

This is the vehicle for supplying oxygen. The quantity of oxygen per unit quantity of air is affected by the moisture, the temperature, and the pressure of the atmosphere. Changing atmospheric conditions necessitate changes in air supply to maintain a constant oxygen supply for constant combustion conditions.

Fluxes

All impurities forming slags with the active fluxing agent should be at a minimum.

Melting

Charging

The chemical analysis and physical properties required determine proportions of charge constituents. Cupola dimensions fix charge-weights and material dimensions—maxima for individual pieces to avoid scaffolding and baffling effects. Order of charging, more important with steel-bearing charges, is determined by the carbon pick-up characteristics of the cupola. Low pick-up cupolas require steel charging on to coke, followed by, say, return scrap and pig-iron, the reverse order being used with high pick-up cupolas, depending, of course, on carbon content required.

Level charging is vital; each coke-charge should be a complete layer between metal-charges. The charging-rate, fixed by melting-rate, should maintain the stock at charging-sill level.

The charge-coke weight, fixed by cupola dimensions as a 7 to 8 in. layer for optimum conditions, determines the weight of metal-charge according to the metal/coke ratio required. Compensations for coke compositional variations can be made to either coke or metal charge.

Air Supply

The melting-rate is a "carbon—or coke—burning-rate." For given combustion conditions the air—of predetermined oxygen content—to burn 1 lb. of carbon is fixed, hence, volume of air in unit time is fixed. Consistent product needs constant melting-rate, meaning constant volume at constant pressure. Reliable, correctly fitted gauges are needed.

The tapping-rate should coincide with the melting-rate. It is controlled by correct timing in intermittent, or correct tap-hole size in continuous tapping. Slagging-out, done most efficiently with a full well, should be at regular intervals. Tuyères should be kept slag-free by judicious poking which also keeps the coke-bed solid.

Cupola control ends with hot metal in really hot, clean ladles of known capacity—this hot metal having properties predetermined within very close limits. Regular observations of melting conditions, of the condition of the metal at the tapping-spout and in actual casting, and regular examinations of the slag, of the drop and the lining at the end of a blow are as vital to successful control as are regular analyses and physical tests of the final product. Only on accurate knowledge is stable progress based.

Discussion

MR. BUNTING, in opening the discussion, congratulated Mr. Payne on being the winner, and also highly commended the other entrants, adding that they were the very best set of Papers ever submitted. The author of the winning Paper said the cupola was a law unto itself and the operator a law unto himself, but he did not think the reference to the law was correct. In a personal experience extending over 46 years in foundry work, he (the speaker) had not yet found a cupola that conformed to any law, and cupola operators are noted for being very temperamental. A second point was that the author recommended poking through the tuyère, which he doubted was good practice, and wondered if good results had been consistently obtained. Mr. Bunting said he was not clear as to pressure and volume, as it was suggested in the Paper that good pressure was preferable to good volume. Pressure was not the goal of cupola practice, and he considered volume to be more important than pressure.

What exactly did the author mean by patching and air drying, as foundries quite often operate two cupolas on alternate days; what was meant by "reasonable drying time"? The cupola must be ready for the next day even if it did not need patching. The author also mentioned carbon was a source of heat. Carbon must combine with oxygen, therefore oxygen was as important as carbon.

Tuyère Poking Practice

MR. PAYNE, in reply, said the statement "Every cupola is a law unto itself" was a tacit admission of the large field of knowledge of the cupola yet to be gained. The greater knowledge possessed, the more definite would become general laws for all, *i.e.*, cupolas in general, not merely a certain cupola under consideration.

Poking through the tuyères in ideal practice would be not only bad practice but totally unnecessary. In actual practice, however, judicious poking was essential if slag-free tuyères and a solid bed were to be assured. This judicious poking had made a very noticeable improvement to the metal obtained on all cupolas of which the author had had experience.

Pressure of air was no criterion of melting conditions. It was the blast-volume that was paramount, but when a cupola was operating with a constant, optimum, air-volume, then pressure-variations could be taken as "barometer readings" of conditions inside the cupola.

When patching was applied to the lining, this material should be allowed to dry out for the longest possible time, at the normal atmospheric temperatures. The length of time available for this "air-drying" was governed by the frequency with which the cupola has to be used. In one case in the author's experience it had definitely paid to get a man working nights, to re-patch a cupola in daily use.

Carbon and oxygen individually were useless to the cupola operator, but when brought together in combustion, heat was produced, the carbon being the source of heat only as far as the solid fuel—coke—was concerned.

Formation of Tap-holes

MR. HALLAMORE asked whether the cupola envisaged was one of imagination or reality. Was it charged manually or by mechanical method, and which method did the lecturer recommend? Mention was made of regular tapping. What method was used to form a regular sized tapping hole? The lecturer also stated that coke should be measured by weight. Did he consider this a better method than measuring coke charged by volume?

MR. PAYNE said that the Paper did not describe the working of a particular cupola, but set out the principles on which every cupola could be operated. The use of hand or mechanical charging was immaterial, provided uniform and level charging was achieved—a factor needing control in either method. Regular tapping-holes would appear to be best formed by using shaped bricks, with the tap-hole or holes of standard dimensions to within fairly close limits. Refractory brick manufacturers had both plant and experience in production of standard shapes, and could best solve this problem.

The ultimate aim in charging coke was to charge a definite weight of carbon. Measuring coke by volume was not upset by variable moisture contents, but certainly did not correct for variations of ash or volatile contents,

Standardisation Amidst Variables

MR. ROXBURGH, who also congratulated Mr. Payne on his effort, stressed that the Author had chosen the title of his Paper well, because in the short time at his disposal it was only possible to outline the principles of control but, nevertheless, he had managed to put a great deal into a small space.

He endorsed Mr. Bunting's observations that every cupola seemed to have, so to speak, its own individuality. Personally, he had had experience of many cupolas and had found that design and practice did not appear to be standardised but, nevertheless, it would be agreed, there were always fundamental principles on which these should be based. In cupola practice, there were many variables to control but, it would be admitted, any process was better for some degree of scientific control which might be exercised.

Despite this control, however, one still obtained differences in temperature and composition of the metal. Cupola practice must be varied in the manufacture of different types of cast iron, for instance, different practice and conditions must prevail with high steel mixtures in comparison with those for high phosphoric irons. The fact, too, that a cupola might be regularly called upon to melt during one "blow" probably half a dozen different mixtures of iron, caused complications. In such cases, consideration must be given to the order of charging of these various mixtures and contamination of one with the other cannot really be avoided. Arising from this, too, the size of the well, which held the molten metal, and the amount and frequency of each tap, were important. It should be decided as to whether the well should be large enough to hold one, two or three charges and perhaps Mr. Payne would express his opinion on this point.

With special irons, high steel-mix or alloy, where the temperature of the metal when tapped was of paramount importance, the amount of coke used should be increased as the temperature of the metal should not be sacrificed for economy of coke. Some foundries had to charge large size scrap, up to 2 cwts., at times, into the cupola and naturally more coke was required than where small "pigs" and scrap are used. With regard to tuyères, what shape did Mr. Payne recommend and did he favour one row or several rows?

Cupola practice was a very wide subject and he would strongly recommend Mr. Payne to prepare a Paper, so that the members could have a further opportunity of discussion at greater length.

Well Capacity and True Coke Economy

MR. PAYNE, in reply, said Mr. Roxburgh's appreciation of the Paper was most encouraging, and he agreed with his suggestion that the subject warranted a more extensive treatment. As far as the "individuality" of a cupola was concerned, the more details known of its design, and the more standardised the operation, the greater the ability to control and predict the result.

The results required in the castings determined the mix used, the type of mix determining the properties of the molten iron according to the coke ratio used. Level charging of both metal and coke, and a complete coke layer between each charge of metal, were the prime factors in reducing charge contamination or dilution, to a minimum. With level charging, the use of extra coke charges, to cause slight delays in the melting of the first charge of a different mix, began to take effect.

The well capacity in terms of number of charges was a combined function of the maximum tap weight required, and the diameter of the cupola. The capacity should never be less than one charge and never in fractional multiples of a charge.

Economy of coke was a phrase that had been grossly abused. The truest economy of coke was its use in the ratios, determined by carefully-made observations, to give greatest efficiency, assessed by a study of purely metallurgical foundry troubles arising during the periods covered by the observations. The optimum coke-ratio could be determined in the coke office. The maximum weights of individual pieces of the charge would be governed by the diameter of the cupola, obviously the larger the cupola, the larger the pieces—within limits—that could be charged.

Tuyère designs were legion as regards both shapes and arrangements. The obvious criteria were the simplest shape and the minimum number of tuyères to admit the volume of air required with maximum uniformity of velocity and distribution over the cross-section of the cupola.

Vote of Thanks

MR. POLLARD, in proposing the vote of thanks, said the meeting had certainly listened to some very good Papers and it gave him great pleasure to assume this duty, as the winner was one of his colleagues. The discussion had shown how much these Papers were valued by the members and he would also include in this vote of thanks the names of the authors of the remaining three Papers: Mr. Holland, Mr. Hallamore, and Mr. Cox.

MR. DUNLEAVY, who seconded the motion, said the chief fault was that time was far too short for a full discussion.

MR. PAYNE, replying for the authors, said he had no doubt they had all enjoyed preparing the Papers and it was very gratifying to know that the members had received them with such interest.

Moulders' Boots and Purchase Tax

It has been found that certain boots (Class 1 (a) Protective Boots) which do not attain the requisite standard of protection have been sold, free of tax, under the exemption in respect of protective boots designed for use by miners, quarrymen or moulders. In order to remove uncertainty as to the types of protective boot which are eligible for exemption, the Commissioners, after consultation with representatives of the industry, have decided to amplify the conditions to be fulfilled when such exemption is claimed. Special attention is therefore directed to the following requirements which are substituted for the conditions laid down in paragraph 6 on page 6 of Notice No. 78.

The exemption in favour of protective boots designed for use by miners, quarrymen or moulders relates only to boots complying with all three of the following conditions:—(*a*) With padded tongues; (*b*) having toecaps which comply with the Grade B specification* of the British Standards Institution for protective toecaps of boots used for industrial purposes; and (*c*) with a minimum of 40 hob nails to each boot; or, in the case of a moulder's protective boot, having an outside apron tongue covering the whole of the lacing.

In future any trader selling boots free of tax under this exemption must satisfy himself that the boots comply strictly with the above conditions. As regards condition (*b*), he must be able to show, when required:—(1) That the boots are fitted with steel toecaps of not less than 1/20 in. in thickness; or (2) that a specimen boot has been certified through the British Standards Institution to comply with the prescribed specification Grade B, and that only boots which attained the standard of the specimen tested and passed are sold free of tax.

In cases where a specimen boot has already been passed by the Commissioners, no further test is necessary, provided the standard is strictly maintained. Invoices in respect of boots which are claimed to be exempt from tax should be endorsed to show that the boots comply with condition (1) or (2) above, as the case may be. Manufacturers are advised, where practicable, to mark the boots which comply with these conditions.

U.S. Steel Corporation

The United States Steel Corporation reports earnings of $36,560,000 in the March quarter, equal to $3.47 per share, compared with $17,114,000, equal to $1.24 per share, for the corresponding period of last year. A contingency reserve of $5,000,000 has been formed for additional taxes and other contingencies resulting from the current high operations. Deliveries during the first quarter gained 9 per cent. over the fourth quarter and 60 per cent. over the first quarter of 1940. The direct cost of recent wage increases is estimated at more than $62,000,000 annually. The Corporation announces a dividend of $1 per share on the common shares, making $2 for the year to date. The total for 1940 was $3.

* This specification (No. 953) has been published by the B.S.I. 28, Victoria Street, London, S.W.1, and can be purchased from them price 2s. 3d. post free.

Institute of British Foundrymen

WEST YORKSHIRE BRANCH ANNUAL MEETING

The annual general business meeting of West Riding of Yorkshire Branch of the Institute of British Foundrymen took place on April 26 at Bradford Technical College, under the retiring presidency of Mr. H. A. MacColl, B.Sc., formerly of Bradford and now of Staffordshire.

MR. S. W. WISE, honorary secretary, in his report, commented on the Branch's decision as to policy under war conditions. In December, 1939, all members received a letter from the Council intimating that it was intended to carry on Branch work as near to usual as circumstances would permit and that up to the moment attendance at meetings had fully justified that decision and members were invited to give their hearty co-operation in support of this policy. "That (stated Mr. Wise) was written at a time when all parts of the country were considered safe (or unsafe). Now, at the end of this year, when the Branch, under the presidency of Mr. MacColl, has by its actions fully endorsed the trenchant and vigorous policy outlined in the circular letter of the then President (Mr. S. Carter), it can truly be stated that members have given the support which was so confidently asked and expected. Every meeting arranged for the past year has been held and the custom of having the annual dinner as the first gathering of the new calendar year, was maintained as in previous years, with the exception that on this occasion artistes were engaged for a musical entertainment for the time previously occupied in dancing."

It had not been possible under war conditions —for obvious reasons—to arrange the customary series of works visits, but the Branch Council was alive to the importance of this feature and arrangements would be made immediately an opportunity should arise. Attendances during the past session had been very gratifying, especially bearing in mind the wide travel area covered by the Branch membership and the fact that all or most of the members were engaged on work of national importance. It was pleasing to note also that the numerical strength of branch membership had been maintained.

Mr. Wise, in conclusion, tendered the thanks of the Branch to those who had contributed Papers and to the discussions, and to Principal H. Richardson, of Bradford Technical College, for facilities for the meetings, and added his own personal thanks to his fellow officers and members for kindly support and friendly help during the year.

The New Officers

Mr. W. Fearnside, of Keighley, member of the Branch during the past 12 years and on the Council for the past six years was elected the new President; Mr. F. Oldershaw (Wakefield) and Mr. L. Turner (Elland), senior and junior vice-presidents, respectively; Mr. S. W. Wise (Bradford) was re-elected hon. treasurer and hon. secretary; Mr. H. Forrest and Mr. W. G. Thornton (both Bradford) were re-appointed hon. auditors; Mr. F. Squires (re-election) and Mr. C. Hall as registrar and librarians. Mr. S. Carter (Huddersfield) and Mr. H. Forrest (Bradford) were re-appointed to the Technical Committee of the Institute—warm tributes being paid to the work of this body for the benefit of the industry and, under present conditions, also in conjunction with Government needs. Mr. W. G. Thornton (Bradford) and Mr. A. S. Worcester (Huddersfield) were re-elected delegates to the General Council. Mr. H. Balm, Mr. C. Hall, Mr. D. Jepson, M.Sc., and Mr. G. H. Copeman were elected to the Branch Council.

MR. FEARNSIDE, accepting the Presidency, appealed to the younger members for more active participation, for whatever they put into the work of the Institute would not only benefit the organisation but would benefit themselves now and even more so in after years.

MR. A. S. WORCESTER, proposing a vote of thanks to the retiring President and officers, paid special tribute to Mr. MacColl, who had carried on with his responsible office in spite of the fact that his removal to Staffordshire involved lengthy travel to the meetings through a winter in which there had been some exceptionally bad conditions. Both Mr. Thornton and Mr. Wise endorsed this tribute to Mr. MacColl.

MR. MACCOLL, before vacating the Presidency, said the Council of the Branch hoped and expected to carry on Branch activities as usual next winter, and would welcome offers of Papers for discussion.

MR. WISE said the General Council were expecting to arrange for a series of Papers which could be circulated to the Branch for their discussion if they were in any difficulty about getting Papers of their own. This was quite a helpful offer on the part of the central body, but it was for the Branch itself to say whether it would like a programme of that kind or prefer to depend more or less entirely on original Papers. Mr. Wise said his own personal preference would be for original Papers of their own so far as they could be obtained, though the offer of the General Council was appreciated.

MR. MACCOLL supported the Secretary's preference so far as it may be practicable. The disadvantage of the circulated Paper was that it had to be read by somebody who was not its author and who, therefore, was not in a position to answer questions or criticisms arising in discussion, and that, of course, necessarily reduced the value of the occasion.

MR. S. CARTER said the West Yorkshire Branch had some of its own members who were doing specialist work, and it was to be hoped they may be able to secure some contributions from such members towards next session's programme.

MR. THORNTON supported the preference for Papers arranged direct by the Branch so far as possible.

MR. OLDERSHAW said he was willing to give a lead to the members by offering at once to prepare a Paper dealing with "'Products' of the Cupola."

Disposal of Pickle Liquor

According to the 1940-41 Report of the Mellon Institute of Industrial Research, Pittsburgh, the activities of the American Iron and Steel Institute's fellowship have related chiefly to certain of the more promising processes for treating waste pickle liquor. The lack of adequate markets for the iron salts readily obtainable from the spent liquor is a serious problem in many of the proposed processes of treatment. Laboratory experiments are in progress to ascertain if the sulphuric acid recovered from waste pickle liquor is a serious problem in many of the proposed processes of treatment. Laboratory experiments are in progress to ascertain if the sulphuric acid recovered from waste pickle liquor by certain processes can be satisfactorily re-employed for cleaning the surfaces of iron and steel. The results to date appear favourable, but pilot-plant tests will be made before final conclusions are drawn. The attention of many steel companies has been focused on the improvement of pickling operations, with good results in increased efficiency of utilisation of the acid consumed and smaller quantities of waste acid discharged.

United States Iron and Steel Output

Production of coke pig-iron in the United States in February totalled 4,197,872 net tons, compared with 4,663,695 tons in January last and 3,311,480 tons in February, 1940. Daily output dropped slightly from 150,441 tons to 149,924 tons in February. The operating rate for the industry, based on the capacity as of December 31, 1940, was 95.2 per cent., against a revised figure of 95.5 per cent. for January. There were 202 furnaces in blast on March 1, operating at the rate of 148,555 tons a day, compared with 205 on February 1, making 152,040 tons.

February production of steel ingots totalled 6.250,413 net tons, divided as follows:—Open-hearth, 5,683,104; Bessemer, 378,330; electric, 188,979 tons. Output in January was 6,943,084 tons. The rate of operation was 96.8 per cent. of capacity, slightly below the 97.1 per cent. operation in January.

The American Iron and Steel Institute reports that 5,163,912 net tons of semi-finished and finished steel was produced for sale in January. A higher average yield from the ingot is revealed by the January report, which shows 71.2 per cent., against 68.9 per cent. in December. The highest rate of operation in any major finished-steel line was in sheets, of which production was 101 per cent. of capacity. Other products with high production ratings were: structural shapes, 82.5 per cent.; sheared and universal plates, 82.6 per cent.; bars, 86.9 per cent.; mechanical tubing, 90.5 per cent.; drawn wire, 91.6 per cent.; cold-rolled strip, 81.8 per cent.

Though steel exports at 653,798 tons were lower in January than in the previous month, yet Great Britain actually received a greater quantity than in December. Scrap and machinery exports were also lower, as much less was despatched to Japan and Russia, especially in respect of machine tools.

Registration of Storage Space

The Board of Trade have made the Storage Facilities (Information) Order, 1941 (S.R. & O., 1941, No. 641), under which every person who owns premises situated in Great Britain (1) of which the floor area is 3,000 sq. ft. or more, and (2) which have at any time since January 1, 1938, been used for the purpose of storing goods of any kind, whether or not they are now being used for storage or other purposes, is required to give certain information about these premises. Owners of such premises should, therefore, apply as soon as possible either to their local Chamber of Commerce; any office of the Federation of British Industries; any office of the National Union of Manufacturers; or the Registrar of Factor and Storage Premises, Board of Trade, Millbank, London, S.W.1, for a form of return on which this information may be given. This form must be returned completed to the Registrar on or before June 2 next. Several classes of storage premises are excepted from the provisions of the Order, including garages; premises used mainly in connection with a factory and situated within one mile from that factory; premises in respect of which a "return of factory premises" has already been made; premises owned by local authorities and most public utility undertakings, etc. More than 14,000,000 sq. ft. of additional storage space is now required by Government departments for munitions, equipment, food, valuable raw materials and other essential goods. The information made available by this return will enable the Controller General of Factory and Storage Premises to assist service and supply departments in dispersing essential stocks.

American Society for Testing Materials Activities

IMPACT ON FOUNDRY INDUSTRY

The 1941 Committee Week of the American Society for Testing Materials, held in Washington, D.C., March 3 to 7, was marked by more meetings of the Society's technical committees than have been held in any previous year and by the registration of over 1,000 engineers.

This Committee Week, as it has come to be termed, provides an opportunity for scheduling meetings of as many committees as wish to take part, in a concentrated period, thus conserving the time of members at meetings, travelling expenses, and the like. While the location of the meetings has influence on the number of committees taking part, the unusual extent of these 1941 meetings and the results of the sessions is a definite indication of the intense activity in materials standardisation and research as carried out by the A.S.T.M.

Practically every one of the more than 200 meetings, including sub-committee and main committee meetings, were well attended. Resulting from the discussions will be many new purchase specifications, testing procedures, needed research data on materials and other information. Most of the material will be included in the annual reports of the committees to be presented at the Society's annual meeting in Chicago—June 23 to 27.

There was notable acceleration of the Society's work in developing quality specifications for materials undoubtedly brought about in large part by national defence exigencies, but also responsible is the unified action which recently has become in effect in the Society's standardisation procedure. A.S.T.M. work has been of profound influence in connection with the production of materials and it is the feeling of many leaders in the Society that one of its most effective contributions in the present emergency is to push forward both research and standardisation activities as rapidly as possible.

Progress in Cast Iron

The Committee A-3 on Cast Iron standardised a new testing procedure, and made a thorough review of the activities of its sub-committees. The tentative specifications in need of revision under the time limit rules of A.S.T.M. were brought to the attention of the various chairmen and definite action requested. Similarly, specifications of long standing which apparently no longer are in accord with latest practices are to be reviewed by the respective groups responsible and portions which need modernising are to be revised.

Amongst the interesting reports submitted by the sub-committee chairmen were those on microstructure and impact testing and on methods of testing. The committee on microstructure which has been working jointly with the American Foundrymen's Association committee is reporting a recommended method for classification of graphite in grey iron which Committee A-3 is submitting to Committee E-4 on Metallography for review.

Dr. J. T. MacKenzie, chief chemist, American Cast Iron Pipe Company, reported as chairman of his Sub-committee XV on Impact Testing that it had approved details of construction for a drop test machine and will report for publication a recommended practice for both types of impact test, one using a Charpy test on a properly prepared broken transverse test-bar and the other using a repeated drop test.

Sub-committee XI on Methods of Testing, under the chairmanship of Mr. V. A. Crosby, metallurgical engineer, Climax Molybdenum Company, has been given a new assignment. It will act as a clearing committee on details of all new test methods which are brought forward from time to time by the various sub-committees. In line with this, the committee reached agreement on standardised procedures for carrying out the following tests on cast iron: Compression shear, and torsion. These methods are to be covered in one document. One of the matters discussed at the meeting was the desirability of securing more widespread familiarity with standardised testing procedures and the committee will appreciate co-operation of any parties who wish to direct attention of foundries in U.S. and Canada to this work. One project which may be undertaken is possible joint action with the Grey Iron Committee of the American Foundrymen's Association on developing talks by competent speakers on the subject of cast iron and the desirability of using standardised specifications and testing procedures, these talks to be given at various local meetings.

Fresh "Malleable" Specifications Proposed

One of the important subjects discussed at the meeting of Committee A-7 on Malleable Iron Castings was the demand for quality specifications covering particular applications of the materials. The result of the deliberations was to instruct the sub-committee on cupola malleable iron to start the formulation of suitable standard requirements covering malleable fittings. The sub-group concerned with pearlitic and alloy malleable iron plans, in line with this same general subject, is to consider the possibility of separate standardised specifications covering the various types of this material as manufactured.

A change in nomenclature to accord with latest concepts of the properties of malleable iron was approved by which the reference to yield point in the various standards will be changed to yield stress. This matter is to be referred to letter ballot of the committee with the intent that it will become effective probably in 1942 when the next Book of A.S.T.M. Standards is issued.

Amongst the functions of the various technical committees of the American Society for Testing Materials is the sponsoring and developing of information on the properties and tests of the respective products covered. Committee A-7 has been active along these lines and at the meeting there was discussion on information and data which are available on the creep resistance of malleable iron and the effect of small amounts of chromium on this material. An effort is to be made by the committee to have these data correlated and possibly offered for presentation at a meeting. The problem of galvanising embrittlement is one which is being studied and there is a possibility of a Paper or report being developed within the next year.

In connection with the work on yield point and yield stress, Prof. R. D. Landon, who is a consulting member of A-7, presented a Paper at the 1940 A.S.T.M. annual meeting, covering "Stress-Strain Relations for Malleable Cast Iron in Tension with Special Attention to Yield Point Determination." One of the A-7 sub-committees, covering air-furnace and electric malleable iron, was requested to review the results of Prof. Landon's Paper and consider whether any changes in specifications are necessary because of the information developed.

New Non-Ferrous Specifications

The Sub-committee on Copper-Base Alloys for Sand Castings, under the chairmanship of Dr. G. H. Clamer, Ajax Metal Company, has been especially active during the past year. This sub-committee has completed seven new tentative specifications for sand castings which will be companion standards to the specifications for copper alloy ingot (B 30-40 T) presented to the Society last year. The proposed new specifications cover the following:—Tin-Bronze and Leaded Tin-Bronze Sand Castings; High-Leaded Tin-Bronze Sand Castings; Leaded Red Brass and Leaded Semi-red Brass Sand Castings; Leaded Yellow Brass Sand Castings for General Purposes; High-Strength Yellow Brass and Leaded High-Strength Yellow Brass Sand Castings; Aluminium-Bronze Sand Castings; and Leaded Nickel-Brass (Leaded Nickel-Silver) and Leaded Nickel-Bronze (Leaded Nickel-Silver) Sand Castings.

Light Alloys

At its meeting held during A.S.T.M. Committee Week in Washington, March 3-7, the Society's Committee B-7 on Light Metals and Alloys, Cast and Wrought, gave intensive consideration to steps it might take to assist in overcoming a number of production problems which have arisen because of the great demand for various types of aluminium and magnesium alloys.

One of its actions concerned a review of the specifications for aluminium for use in iron and steel manufacture which now cover four grades. Certain changes are to be made to help in connection with the heavy demand for this type of material. One of the production bottlenecks in connection with aluminium sand castings has been the time involved and the equipment necessary for heat-treating certain type castings to produce high strength. A recent development in this field is a new aluminium alloy which has high-strength properties in the as-cast condition, thus eliminating the heat-treating requirements. Fortunately, this new alloy can be easily cast and with its high strength combines good corrosion resistance.

In connection with magnesium alloys in all forms, the committee is proposing new high-purity grades. Except for this, the alloys apparently have no better properties than the normal grades. Obviously, the high-purity alloys are available from limited sources of supply and at premium prices. In connection with anodic oxidation treatment of aluminium and aluminium alloys for added corrosion protection and abrasion resistance the committee is beginning a programme of tests. Samples of various alloys have been treated by different methods and will be tested by various co-operating laboratories.

Titanium in Cast Iron

The "March" diary issued by the Titanium Alloy Manufacturing Company of New York (the British representatives for which are T. Rowlands & Company, Limited, of Sheffield) contains an article carrying the above caption. It consists of annotated excerpts from "Alloy Cast Iron," published by the American Foundrymen's Association. This is a particularly useful service as the information is obviously dispersed throughout the book in question. The effect of titanium on cast iron needs special treatment as the effects are not consistent through the complete compositional range. For instance, the tensile strength of castings carrying titanium in sufficient amount (0.08 to 0.25 per cent. residual titanium) strengthens irons carrying over 3.4 per cent. carbon, while fine-grained, soft irons, low in combined carbon, may be weakened by titanium additions. Apparently titanium has beneficial effects on the machinability, wear and corrosion resistance properties of cast iron.

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Refined

PIG IRON

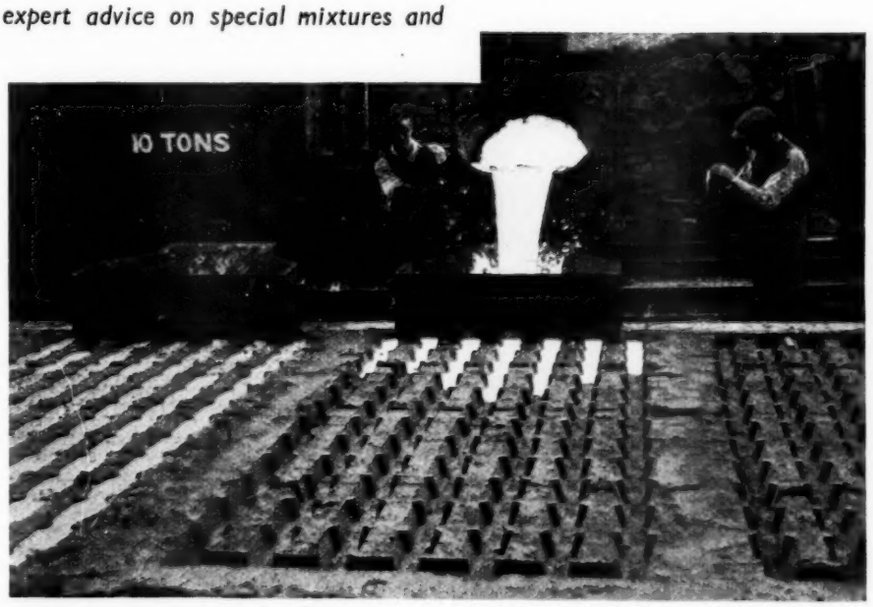
IS CHARACTERISED by closeness of grain structure, uniformity of composition and fine graphitic carbon evenly distributed.

IS PRODUCED to guaranteed analysis in seven standard grades.

CAN BE MADE to customers' individual requirements with total carbon from 2·6 per cent. upwards.

SHOULD BE USED to tone up high phosphorus irons and scrap, to replace Hematite, and to produce castings for all high duty purposes.

Users are invited to avail themselves of the Stanton Technical Service which offers free expert advice on special mixtures and other Foundry problems.



THE STANTON IRONWORKS COMPANY LIMITED, NEAR NOTTINGHAM

The Week's News in Brief

Trade Talk

THE EARLSFIELD FOUNDRY & ENGINEERING COMPANY, LIMITED, is being wound up voluntarily. Mr. J. L. Jeffree, 52-54, High Holborn, London, W.C.1, is the liquidator.

UNDER A BOARD OF TRADE ORDER which came into force on May 14 licences are required to export to all destinations certain engineers' small tools, parts and accessories of machine tools, and machine tool jigs.

THE MINISTER OF SUPPLY has appointed Sir Walrond Sinclair, chairman of the India Rubber, Gutta Percha & Telegraph Works Company, Limited, to be Rubber Controller. The offices of the Control will be temporarily at 12, Whitehall, London, S.W.1.

THE ANGLO-AMERICAN METAL & FERRO-ALLOY CORPORATION announces that it will from now onwards engage in the manufacture of nickel alloys and allied products, in addition to its present field of activity. This industrial branch of the business will be conducted under the name of American Nickel Alloy Manufacturing Corporation. Both organisations will maintain new executive offices at 50, Church Street, New York City.

THE CONTROL OF BALL AND ROLLER BEARINGS (No. 1 Order), which came into force on April 30, prohibits the purchase or acquisition of any ball or roller bearing except from the bearing manufacturers, or for use by the purchaser in production or maintenance of some other article, or under a licence issued by the Minister of Supply. Copies of the Order can be obtained from the Stationery Office, price 1d. Inquiries should be addressed to the Bearing Panel, Ministry of Supply, Great Westminster House, Horseferry Road, S.W.1.

ANSWERING THE QUESTION as to whether magnesium swarf should not be placed in sacks or wooden containers, as fire risk is thereby increased, the "Industrial Accident Prevention Bulletin" states that the presence of wood or sacking does very greatly increase the vigour of a magnesium fire. Swarf should be placed only in non-combustible containers of steel or concrete. If a fire should be started in such a container it can be best extinguished with sand. If the fire occurred at a machine where sand would do damage, non-gritty powders sold for the purpose might be used, though sand is probably most effective. Water in small quantities, even if applied as a spray, is liable to scatter the burning metal without extinguishing it.

FURTHER RECOMMENDATIONS to deal with flooding in Anderson shelters are contained in a new circular (No. 96/1941) which has been issued to all local authorities by the Ministry of Home Security. Many Anderson shelters have been abandoned by the public and local authorities because it is claimed that it is impossible to make them waterproof. The results of a survey carried out by the Ministry show that methods previously advocated for dealing with this problem can be effective if carried out honestly and with care. The circular, Steel Shelters—Cases of Flooding, is on sale at the Stationery Office, price 2d. It contains further suggestions for drainage, concrete tanking, construction of sumps, floors and a method of clay puddling to seal joints. Attention is again drawn to the necessity for placing sufficient earth covering on top and round the sides and back of Anderson shelters.

Sir Ronald Matthews, presiding at the annual meeting in London recently of the Association of British Chambers of Commerce, said that the latest Government requirements for the concentration of production seemed the logical corollary of the policy of limitation of supplies, but the process of concentration was painful, and the businesses affected were entitled to the most definite assurances that their position would be adequately safeguarded when the tide of industry flowed once more in normal channels. Above all, they did not want to find some day that all the sacrifices made by industry under the stress of war were being used as stepping-stones to the imposition of some form of State control without reference to the electorate. If the country wanted nationalisation it could get it through the polls. If private enterprise was to go, it must go according to the rules of democracy and in no other way. In return for the great sacrifices which industry was making willingly for the common weal it was entitled to ask that every effort should be made to secure from the factories of the country the absolute maximum of production. Inquiries showed plainly that for various causes that maximum in many directions was not being attained. Representations as to the causes operating to slow down the war effort had been made to the Prime Minister.

Personal

MR. CHARLES ROBERT JULIAN has been awarded "The Consolidated Gold Fields of South Africa, Limited" gold medal of the Institution of Mining and Metallurgy for his Paper on "Underground Mining at Rio Tinto, Spain."

SECOND-LIEUT. W. M. CUNNINGHAM, Royal Armoured Corps (Hussars), who has been awarded the Military Cross, is the son of Mr. James S. Cunningham, managing director of the Etna Iron & Steel Company, Limited.

MR. C. M. SPIELMAN, of Darlington, managing director of the Whessoe Foundry & Engineering Company, Limited, Darlington, and Durham Steelwork, Limited, has been re-elected president of the Teeside Chamber of Commerce.

Obituary

MR. CECIL THOMPSON, of Bagot & Thompson, Cullum Street, London, E.C., who died on April 30 at the age of 53, had been a member of the London Metal Exchange since 1916.

WE SINCERELY REGRET to announce the death of Pilot-Officer Harold Hugh Hirst, R.A.F.V.R., grandson of Lord Hirst of Witton, who has been killed whilst on operational duties. He was 21 years of age.

MR. LEWIS SMITH, managing director of Smith Meters, Limited, manufacturers of gas and electricity meters, of London, died on April 23. He was a grandson of the founder of the firm and became managing director in 1938.

THE DEATH has occurred of Mr. Henry S. Brown, Barncluith, Meiklerigs, Paisley, who for a number of years was associated with the management of the Ferguslie Fire Clay Works, Paisley. During recent years Mr. Brown was chairman of the British Fire Clay Association.

MR. HENRY GARDNER, chairman of Henry Gardner & Company, Limited, metal and rubber merchants, 2, Metal Exchange Buildings, London, E.C.3, and deputy-chairman of the Amalgamated Metal Corporation, Limited, died on April 27, in his 83rd year. He had been a member of the London Metal Exchange since 1898 and was well known not only in this country but also in the United States, Canada and on the Continent.

Reports and Dividends

Ransomes, Sims & Jefferies, Limited—Dividend of 7½ per cent. (same).

Associated Equipment Company, Limited—Interim dividend of 2½ per cent., tax free.

Ideal Boilers & Radiators, Limited—Net profit for 1940, after taxation and depreciation, £158,309; preference dividend, £50,000; dividend on the ordinary shares of 15 per cent., tax free; carried forward, £198,983.

John I. Thornycroft & Company, Limited—Interim dividends of 3 per cent. on the cumulative preference shares; 3¾ per cent. on the participating preferred ordinary shares; and 5 per cent. on the ordinary shares.

Glenfield & Kennedy, Limited—Net profit for the year to March 31, £67,537 (£70,549); final dividend of 5 per cent. (making 10 per cent.), and a cash bonus of 10 per cent. (against 10 per cent. and a bonus of 7½ per cent. for 1939-40).

Colvilles, Limited—Trading profit for 1940, after providing for deferred repairs and contingencies, £1,132,270 (£1,058,462 for the previous year after writing down investments and providing for contingencies); net dividends from subsidiaries, £96,416 (against £147,522); taxation, £800,000 (£600,000); depreciation, £350,000; net profit, £77,186 (£253,984); dividend on the ordinary capital of 8 per cent., £165,601; dividend on the 5½ per cent. preference stock, £63,250; carried forward, £119,858 (£271,523).

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

L. S. & Company, Limited—Capital, £1,000. Manufacturers of engineering products, etc. Subscriber: M. Harris, 104, North Side, London, S.W.4.

Stockport Engineering Company, Limited—Capital, £1,000. Directors: E. A. Bolton, T. F. Gray, and H. Baldwin, 52, Deeplish Road, Rochdale, Lancs.

C. & A. Stewart, Limited, 36, Falfield Street, Glasgow—Brassfounders, bronze manufacturers, copper and tin smiths. Directors: A. S. Stewart and J. Auld.

Taylors (Liverpool), Limited, 19, South John Street, Liverpool—Capital, £1,000. Dealers in scrap machinery and metals, etc. Directors: J. J. Lawler and J. Taylor.

Home Counties Engineering Company, Limited, 106A, Church Road, Upper Norwood, London, S.E.19—Capital, £5,000. Directors: V. R. R. C. M. Ullman and C. E. Linge.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

531,018 JOHNSON & NEPHEW, LIMITED, R., ROBINSON, W., and TILGHMAN'S PATENT SAND BLAST COMPANY, LIMITED. Descaling or cleaning of rod or wire.

531,021 HORNLIMANN, F. Expansible sheet-metal casing for the production of concrete piles or pillars.

531,032 WILLIAMS, R. Helically-welded metal pipes, and apparatus for the manufacture thereof.

531,091 STAVELEY COAL & IRON COMPANY, LIMITED, and FREER, E. Pipe joints.

531,117 GENERAL ELECTRIC COMPANY, LIMITED, and PRICE, G. H. S. Heavy alloys.

531,119 SUPERHEATER COMPANY, LIMITED. Joining of metal tubes by forging.

531,134 OKONITE-CALLENDER CABLE COMPANY, INC. Method of and apparatus for electrically measuring the wall thickness of metal tubing and for controlling the wall thickness.

531,215 GENERAL MOTORS CORPORATION. Manufacture of multiple tubing.

531,324 ABRAHAM, G. A. Reels for barbed and other wire, and the like.

531,339 SOC. ANON. LOUVROIL MONTBARD AULNOYE. Machine for electrically heating metal bars and tubes.

531,380 MOND NICKEL COMPANY, LIMITED. Methods of applying overlays to ferrous metal bases, and welding-rods suitable for use therein.

531,381 FIDES GES. FUR DIE VERWALTUNG UND VERWERTUNG VON GEWERBLICHEN SCHUTZRECHTEN. Treatment of iron-silicon alloys.

531,466 ETCHELLS, H. Alloys.

531,510 GLEISSNER, P. Rolling-mills.

531,513 AKOMFINA AKT.-GES. FUR KOMMERZIELLE UND FINANZIELLE ANGELEGENHEITEN. Castings, for example tools with sharp edges, cutting edges, corners, or the like.

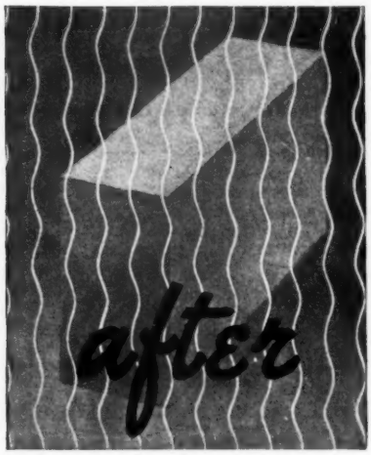
531,525 DIMMICK, G. W. (American Smelting & Refining Company). Apparatus for continuously casting metals.

531,545 ALLOY PROCESSES, LIMITED. (Armandias, L. S.). Furnaces for the reduction of metal ores.

531,573 BRITISH THOMSON-HOUSTON COMPANY, LIMITED. Means for anchoring the tubes of elastic fluid generators to furnace walls.

Hydraulically-Controlled Electric Furnaces

Hydro-Arc Furnace Corporation, 9, South Clinton Street, Chicago, has been incorporated to design, build and sell a new line of electric-arc melting furnaces. The Hydro-Arc furnace has hydraulically controlled electrode regulation incorporating a low-inertia counter-weighting and electrode time-mover equipment.



"G.R." FIREBRICKS which enjoy the confidence of leading engineers:

GLENBOIG SPECIAL:
For use in all types of combustion chambers & furnaces operating at high temperatures.

GLENBOIG SPECIAL CROWN:
For suspended arch blocks and all blocks subject to thermal shock and high temperatures.

GLENBOIG:
Unequalled for general furnace construction, boiler linings, baffles, etc.

GLENBOIG CROWN:
For suspended arch blocks, throat bricks—wherever freedom from spalling is the most important factor.

CASTLECARY:
General Furnace work, boiler linings, etc.

GEM:
All positions where conditions are less severe than those which necessitate the use of first grade Scottish Firebricks.

ADAMANTINE:
Hard vitrified firebricks highly resistant to abrasion—extensively used in cool end of re-heating furnaces.

LLANGENNECH:
For use in secondary positions. Good shape and size.

WHITE CARR:
A general purpose firebrick, especially suitable for ladle linings in steel works.

STOURBRIDGE:
Standard Stourbridge firebrick of excellent shape and size.

HIGH REFRACTORINESS *freedom from spalling*

THESE two important factors are provided for in the range of firebricks supplied by General Refractories. An exacting control of the raw materials available from its many firebrick works throughout the country—the use of the most modern equipment—the rigid application of laboratory tests at each manufacturing stage—these ensure a supply of sound firebricks of uniform quality, shape and size.

The resources of General Refractories enable them to offer a range of refractories suitable for the execution of any contract. The user may, therefore, depend upon receiving carefully considered and unprejudiced recommendations directed solely to ensure maximum life and dependability from his furnace structures.

GENERAL REFRACTORIES LTD.

HEAD OFFICE: GENEFAX HOUSE, SHEFFIELD, 10. TELEPHONE 31113 (6 LINES)

G.P.13

FIREBRICKS: *Glenboig Special, Glenboig Special Crown, Glenboig, Glenboig Crown, Castlecary, Dykehead, Gem, White Carr, Stour, Hycone, Alumantine, Hysilyn, Adamantine, Llangennech.*
BASIC BRICKS: *Spinella, Saxpyre, Supermag, Diazite, Dolomax.*
ACID-PROOF REFRACTORIES: *Obsidianite, Losol.*

INSULATION: *Amberlite* Bricks, Cement and Concrete.
SILICA BRICKS: *Lowood, Meltham, Allen, Quartex.*
CEMENTS: *Sintex, Durax, Pyrolyte.* PLASTICS: *Durax, Rotaline, Plastic K-N., Glendoline, Ground Ganister, Steel Moulders' Compositions.* SILLIMANITE: *Tank Blocks, Bricks and Cements.* SANDS: *Moulding, Brick Facing, Silica, Glass.*

Raw Material Markets

While supplies of common foundry irons, generally speaking, are quite sufficient to meet current needs, the position in respect of better quality irons is less satisfactory. Low-phosphorus iron and hematite, for example, are required in very heavy tonnages by speciality engineering establishments, etc., but home production of these grades is not equal to consumption. Thus, a certain amount of foreign iron is being distributed to satisfy really urgent demands. It is gratifying that imported iron is available when required, but the desirability of keeping down the volume of iron purchased abroad is fully appreciated and every effort continues to be made to introduce measures of economy at consuming plants. In many cases considerable success has accompanied these measures, and it has been found possible to utilise high-phosphorus and refined irons to a greater extent than hitherto.

Pig-Iron

MIDDLESBROUGH—Ironmakers in the Cleveland area are much too busily employed on the production of basic and other irons used in the manufacture of steel to devote their energies to foundry iron production, and the tonnage of this type of iron emanating from furnaces on the North-East Coast represents a negligible proportion of the aggregate requirements of consumers. This situation, however, does not mean that users of foundry grades are going short; on the contrary, adequate supplies are forthcoming from furnaces in Derbyshire and Northamptonshire. Many works have considerable stocks on hand, so that licences are readily granted. Consumption of foundry iron is rather lower than in normal times, owing to the light-castings trade, the chief user, being indifferently employed because of wartime restrictions on their business and the falling off of export trade. Some makers have work for Government departments on their hands, but, as yet, the volume of official contracts handed out to the trade has not been sufficient to counteract the loss of other outlets.

Little change has occurred in the hematite market for some time past; full outputs are moving away and even then a substantial volume of orders remains unsatisfied, but there are difficulties which prevent any expansion of production, and these cannot readily be overcome. Where the use of hematite is vital in the interests of war contracts, the Control authorities are generally able to supplement home production with supplies bought abroad, but every encouragement is accorded to consumers to make use of refined iron, which is more easily produced.

LANCASHIRE—Apart from heavy electrical engineers, machine-tool makers and other speciality engineers, consumption of foundry iron is not impressive in this area, so many makers of light castings being employed at well under full capacity levels, while a number of jobbing foundries would welcome additional business. The outlook for many of these concerns is not very bright, as the amount of work of an official character likely to be placed in the near future does not promise to be substantial, and many peacetime outlets are closed or greatly restricted. Prospects for heavy engineers, on the other hand, are very satisfactory and works will doubtless remain fully occupied for a long time to come, as they are playing no small part in the war effort.

MIDLANDS—Heavy castings are required for the various Government departments in ever-increasing tonnages, so that makers have very full order-books and their demands for pig-iron remain at a very high level. Low-phosphorus iron and hematite are the grades largely used by these works, but the supply is not nearly sufficient to meet all demands and recourse has to be had to refined and high-phosphorus iron, together with a certain amount of steel scrap. This adaptation of mixtures is proving to be more satisfactory than had at one time been thought possible. The position of the light-castings trade does not improve very materially, and it is not expected that there will be sufficient work for the Government forthcoming to enable the trade to operate fully. This being the case, makers of light castings will remain poorly placed, as the call for builders' castings and other of their products is not very brisk, nor is their export business more than a shadow of its normal self.

SCOTLAND—Heavy engineering works, although their requirements are met, continue to experience some delay in obtaining supplies of pig-iron. Consumption among these concerns is substantial, owing to the preponderance of war contracts. Plentiful supplies of iron are being delivered to light-castings makers, whose requirements are not particularly large, they being unable to keep their plant fully engaged. Pig-iron for these works is bought in the English Midlands at 126s. 9d. per ton, f.o.t. Falkirk, and 129s. 9d., f.o.t. Glasgow, less 5s. rebate. Low-phosphorus iron, hematite and basic are all in very insistent demand, hematite being in particularly strong request by steelmakers.

Coke

There is every indication that supplies of foundry coke will be available in sufficient tonnages during the summer months to permit ironfounders to build up useful stocks; deliveries at the present time are very satisfactory, and are in excess of current needs. Coke prices are officially controlled, and the existing quotation for Durham best foundry fuel, delivered Birmingham and Black Country stations, is 61s. 6d. per ton, minimum, in truck loads.

Steel

The flow of steel into the factories employed on the production of requirements necessary for the prosecution of the war effort is maintained, and all urgent demands in this connection are being dealt with satisfactorily. Only in very unusual circumstances are non-essential users permitted to take up supplies, so that it may be said that the steel industry is fully harnessed to the war machine. A certain amount of American material continues to be absorbed, but foreign purchases are not unduly large and will be reduced at the earliest possible juncture in order to release shipping for the transport of other cargoes. Plate mills catering for the needs of shipbuilders, boiler and tank makers, etc., are heavily pressed for deliveries, and their order-books are well filled over a considerable period ahead. Sheet makers, too, are busy, as, also, are forges and drop stampers. The tendency in the steel trade now is for the demand for ordinary commercial grades to fall away and for special qualities to be requisitioned in ever-increasing tonnages for the output of munitions, etc. Consequently, every effort is being made for production of the latter to be enlarged.

Scrap

A slight improvement in deliveries of iron and steel scrap has been reported, but the demand still far outstrips the supply, and it is imperative that better quantities be forthcoming in the near future in order that importations be kept as low as possible. Scrap merchants are quickly disposing of all material that is offered to them, and it is not thought that there is cause for dissatisfaction in this respect, but there are still many difficulties to overcome in regard to the collection of scrap, and it may soon become necessary for the authorities to impose increasing measures of compulsion.

Metals

TIN—Offers of cash tin in the open market continue to be made by the Ministry of Supply and it is undoubtedly the policy of the Ministry to keep prices in this country in line with New York quotations. The tone of the London market has been quite firm of late, while American buying has involved substantial tonnages, due to some extent, no doubt, to persistent uneasiness with regard to supplies of tin in the East. It is believed that a larger proportion than was earlier thought probable of the combined United States March and April tin delivery figure of 30,047 tons was taken up by manufacturers and, consequently, less passed into the hands of the Metals Reserve Company, as according to unofficial estimates, the amount of tin delivered to the company up to April 23 showed very little change from the 30,000 tons estimated to have been delivered by the end of March.

The probability that Germany is experiencing real difficulties with regard to supplies of tin is noted in "Tin," published by the Tin Producers' Association. The journal goes so far as to predict that the shortage of the metal will do more than anything to sabotage the Nazi war effort. An article in "Tin" stresses the vital necessity of tin in the production of armaments, aircraft, etc., and says that any attempt to introduce a substitute for a vital raw material such as tin would result in complete disruption of the industry, and in any case would take many years to develop. Since the beginning of the war practically no tin has been imported into Germany from overseas, while since Hitler came into power imports of tin showed a slight decrease. Of the countries annexed by Germany in recent years only Holland is likely to have provided any appreciable quantity of tin for the Reich, although Russia may have despatched considerable tonnages. Nevertheless, tin reserves must be fast diminishing, and it becomes evident that the tin shortage must be assuming alarming proportions in Germany, concludes the article.

Tin prices on the London Metal Exchange during the past week have been as follow:—

Cash—Thursday, £270 10s. to £271; Friday, £270 10s. to £271; Monday, £270 10s. to £270 15s.; Tuesday, £270 5s. to £270 10s.; Wednesday, £270 to £270 5s.

Three Months—Thursday, £267 5s. to £267 10s.; Friday, £267 5s. to £267 10s.; Monday, £267 5s. to £267 10s.; Tuesday, £267 5s. to £267 10s.; Wednesday, £267 15s. to £268.

COPPER—Although further restrictions have been announced on the use of copper, together with other metals, this need not be taken as an indication that there is a shortage of the metal, but is merely a precautionary measure on the part of the Control authorities and largely concerns the production of luxury commodities. Actually, essential requirements of copper are being met satisfactorily and steady arrivals of fresh supplies are evident. The United States Metals Reserve Company, it is announced, has acquired virtually the whole output during the current year of the American-owned Latin America copper mines. A Reconstruction Finance Corporation report states that 500,500 tons were contracted for up to the end of April. American consumers have been informed by the Government that they must file inventory affidavits with the Government before they will be permitted to make fresh purchases, this ruling being effective as from June 1. Thus, a further measure of Governmental control over copper has been introduced, prices there already being unofficially controlled following a warning by the Administration that it would frown severely upon attempts to raise prices.

SPELTER—While supplies of spelter for the use of war factories are coming forward promptly, little of the metal is finding its way into other sources of consumption, so closely is distribution controlled. In the United States, where the supply situation has given rise to some concern, many new measures of economy are being introduced with good results.

LEAD—For a long time past it has been easier to secure licences for the purchase of lead than for other non-ferrous metals, but it would seem that the Control authorities are watching the position more closely now, although no drastic steps have been considered necessary as yet. Large quantities of lead are on hand to meet the needs of war contracts, while further shipments are arriving regularly.

Instrument Recording Charts

The Permochart Company, Sewickley, Pa., U.S.A., has developed a series of washable recording charts for use with pyrometers and other scientific recording instruments, which are made of plastic material. Yesterday's records are removed by wiping over with a damp cloth. Where a permanent record is required, a microfilm photographic system of recording and filing can be employed. According to the makers, this method reduces filing space by 98 per cent. of that normally required, and a cost analysis shows that, in plants where 100 charts per day are used, a saving of 23 per cent. resulted: if 300 charts per day are used the saving is 42 per cent.